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(56) Documents cited
None

(58) Field of search
B8R

(54) Apparatus for winding onto cores and separating the web

(57) Web is wound onto cores which are introduced to the throat between first and second winder rolls (46,48) and which are advanced through the throat by causing the peripheral speed of second winder roll (48) to be slower than the peripheral speed of first winder roll (46). The web is guided around the first winder roll (46) and commences winding onto the core as it passes through the throat. A diameter control roll (69) acts on the web roll being wound and a differential speed control varies the peripheral speed of the diameter control roll (69) relative to the first and second winder rolls (46,48), eg to eject a fully wound roll between rolls (69 and 48) and separate the web. Alternatively, the speed of roll (69) is changed to cause the web roll to move the wound web roll towards a fresh core introduced through the throat, to trap the web between the fresh core and winder roll (48) and subsequently to separate the web. Perforating rolls (38,39) produce spaced lines of perforations across the web and the location of these lines can be varied by adjustment of the speed of rolls (38,39).

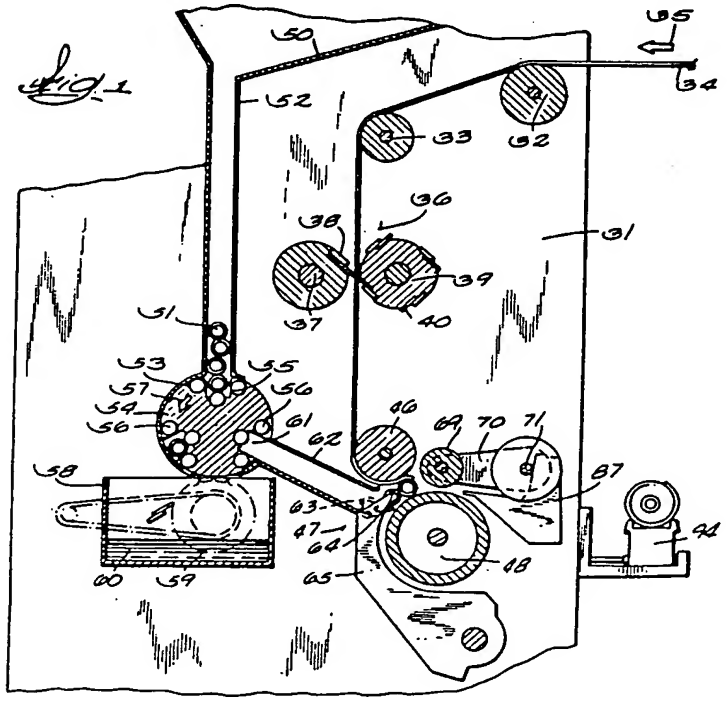

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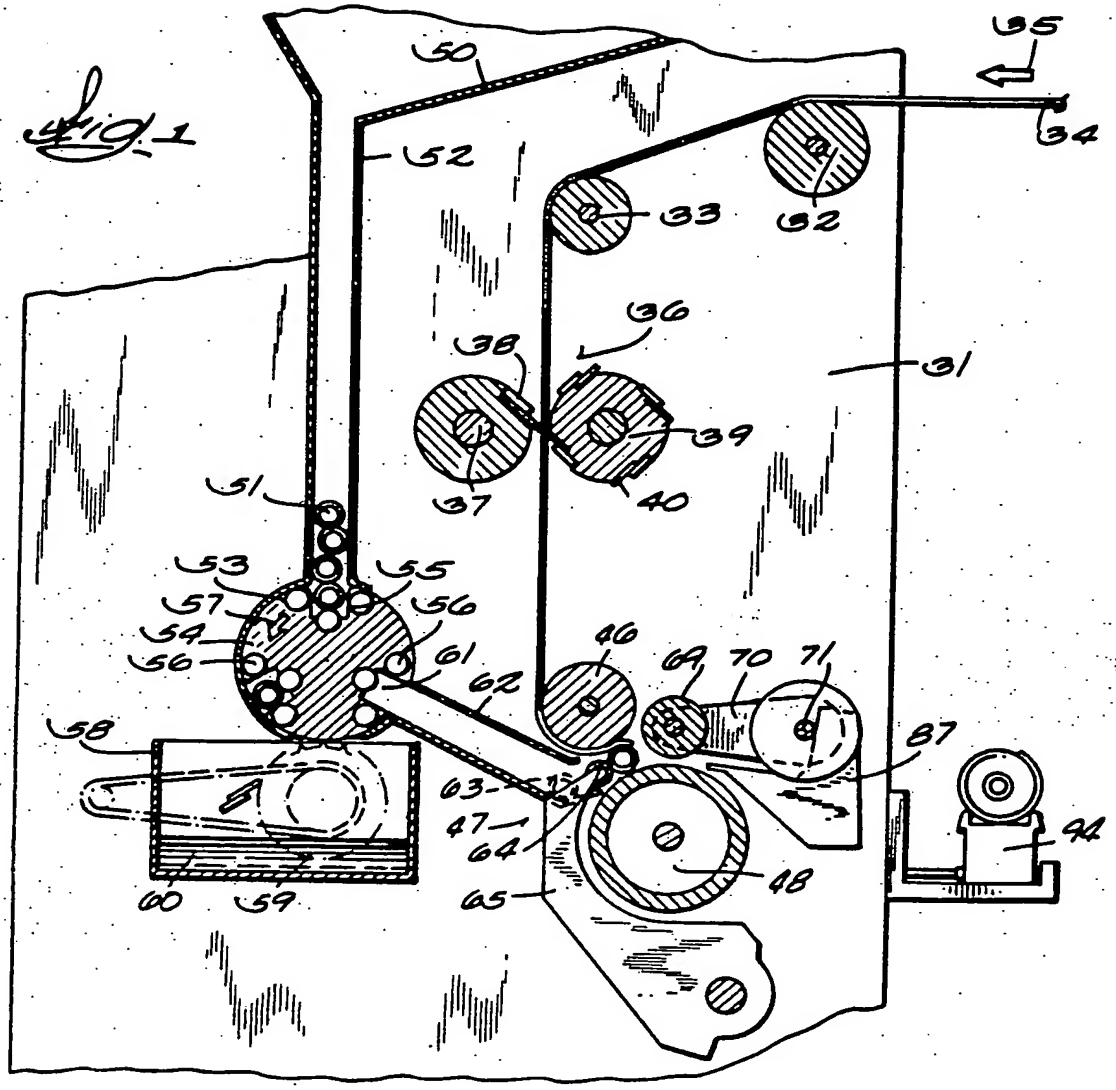
Fig. 1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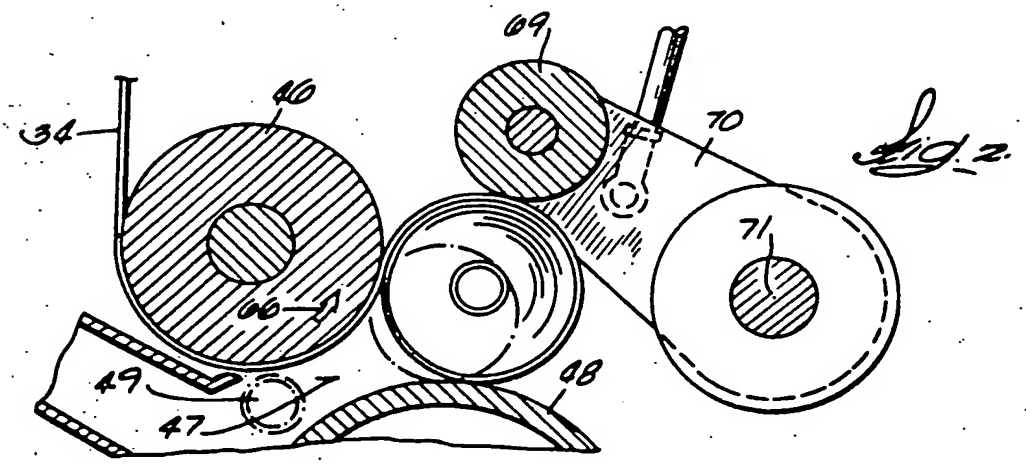
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Fig. 2

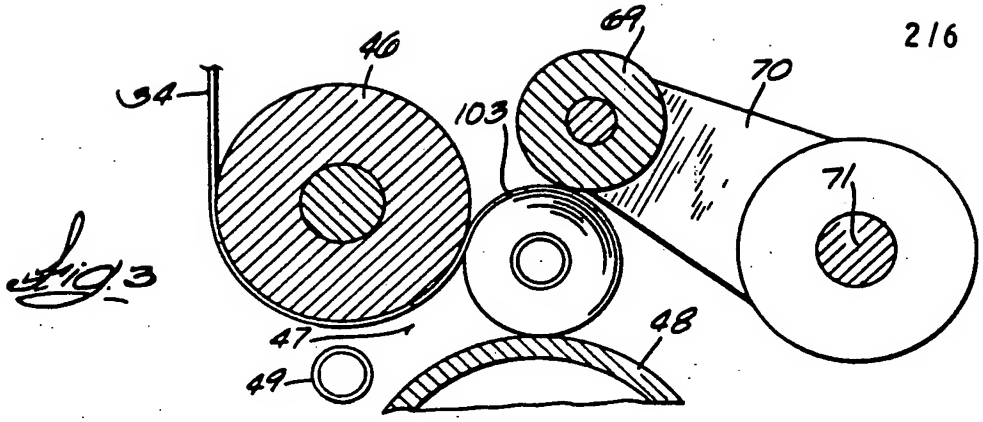

Fig. 3

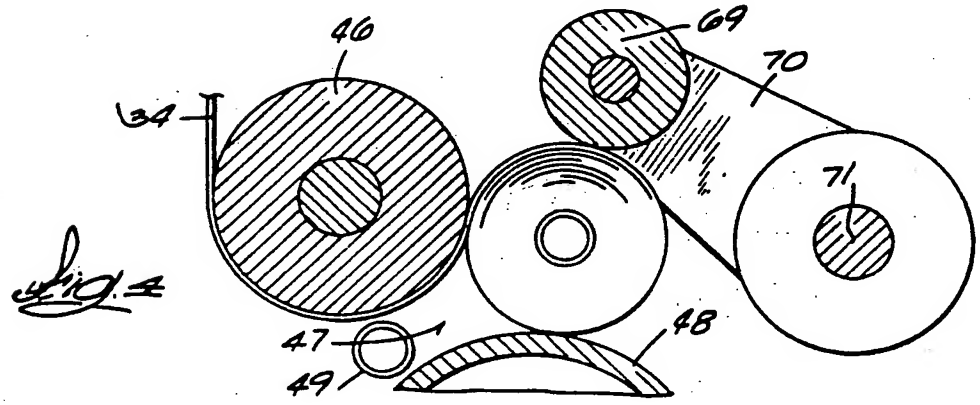

Fig. 4

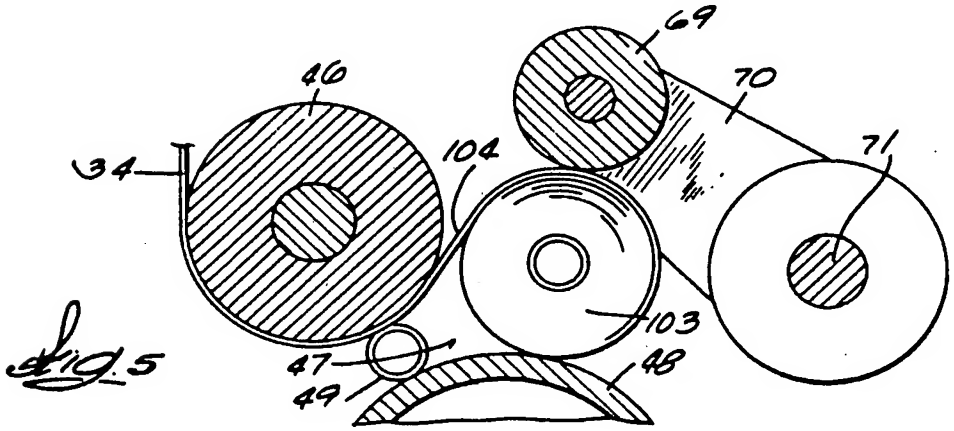

Fig. 5

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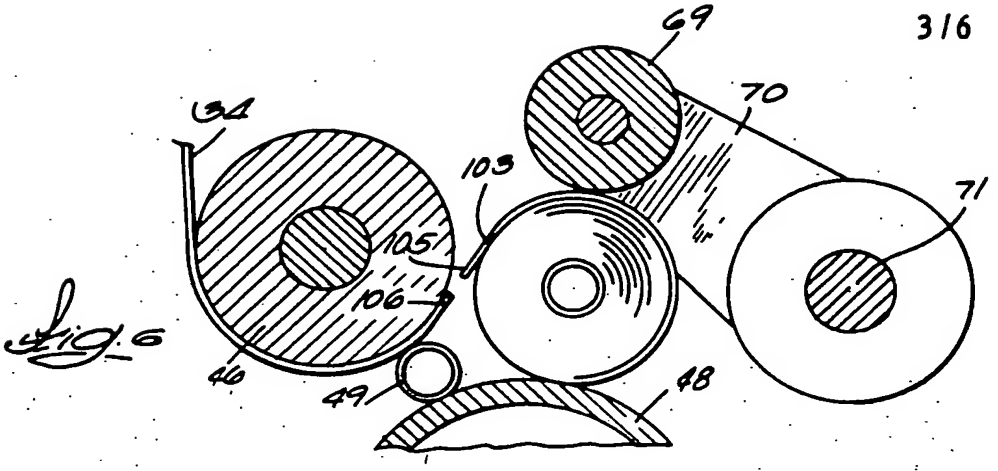


Fig. 6

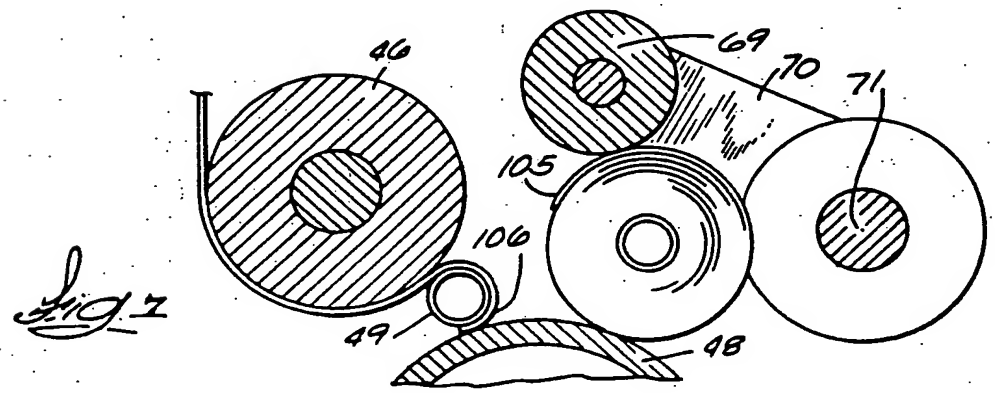


Fig. 7

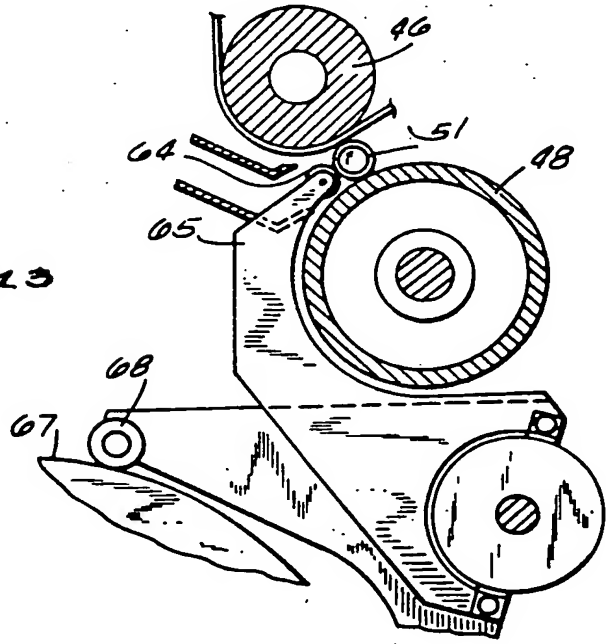


Fig. 13

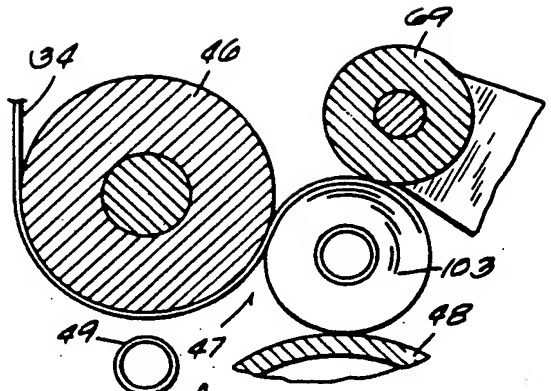


Fig. 8

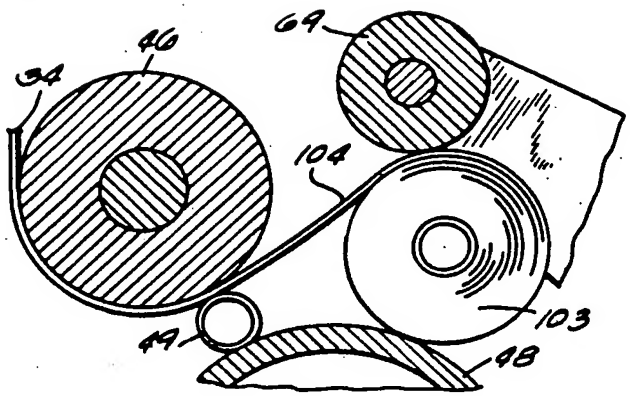


Fig. 9

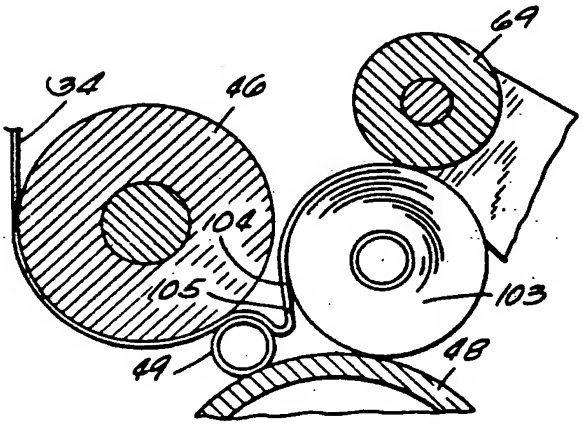
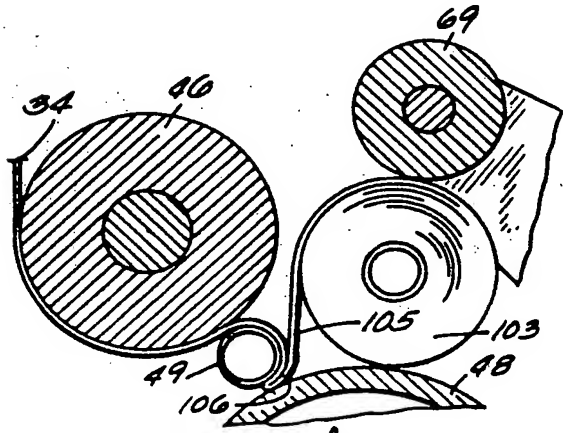


Fig. 10



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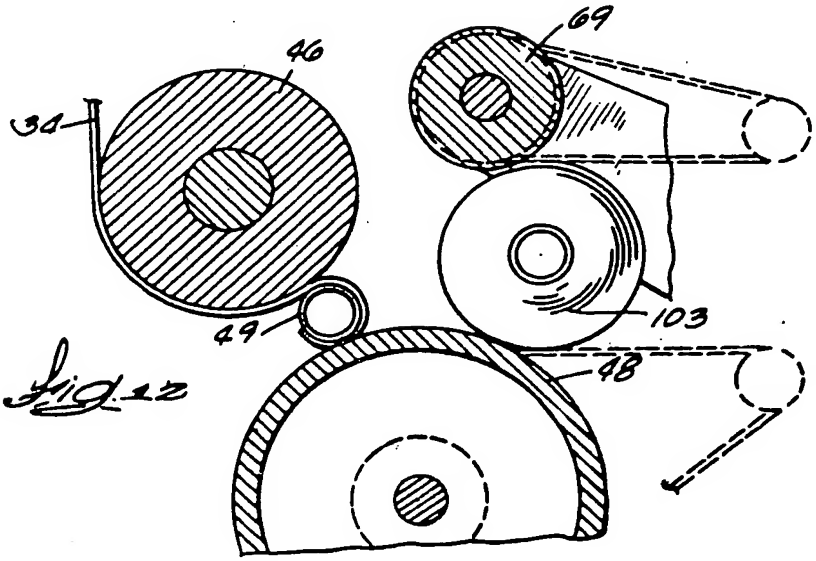

Fig. 12

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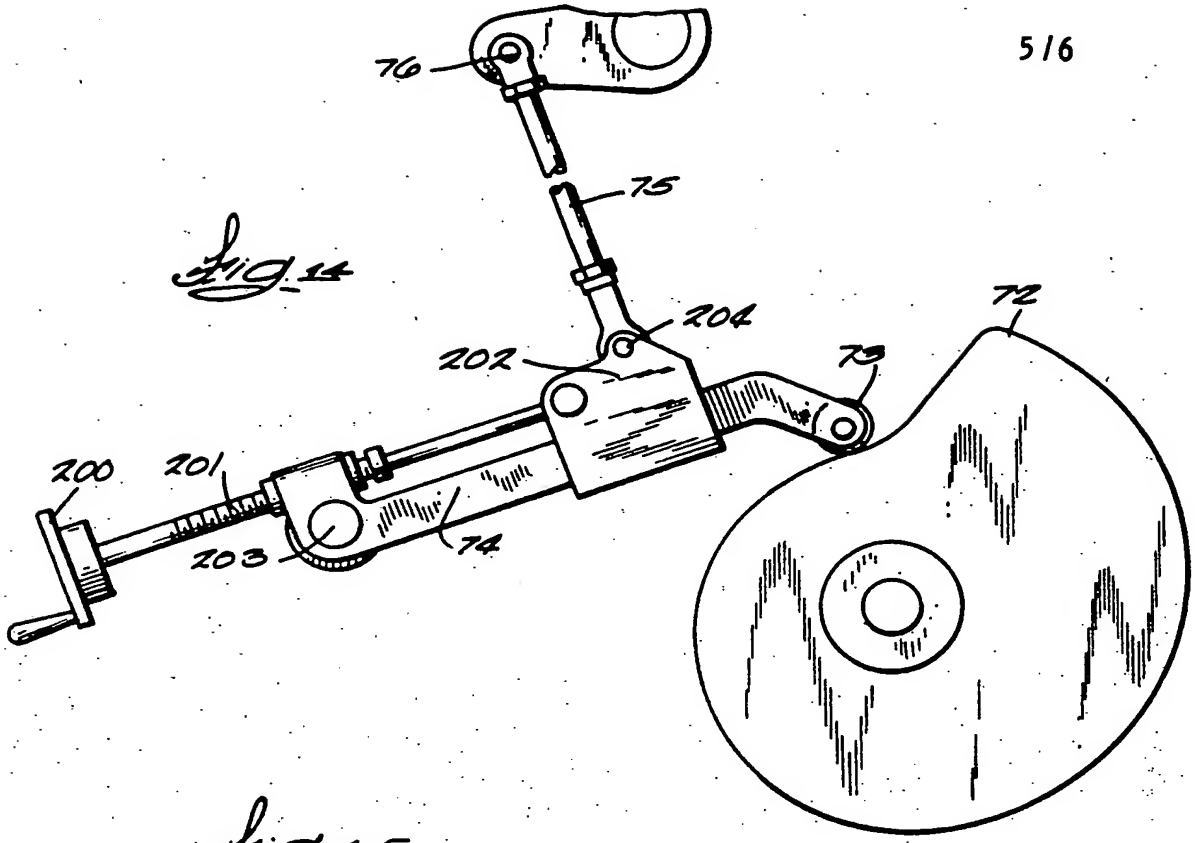
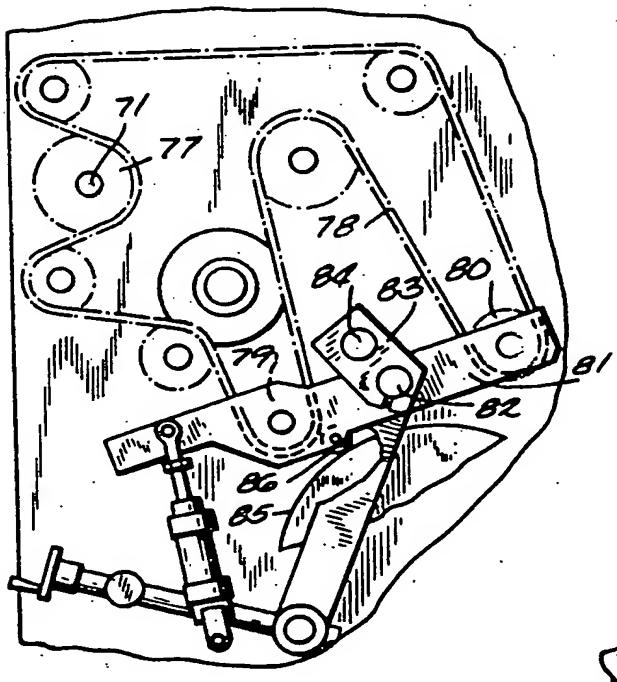


Fig. 14

Fig. 15



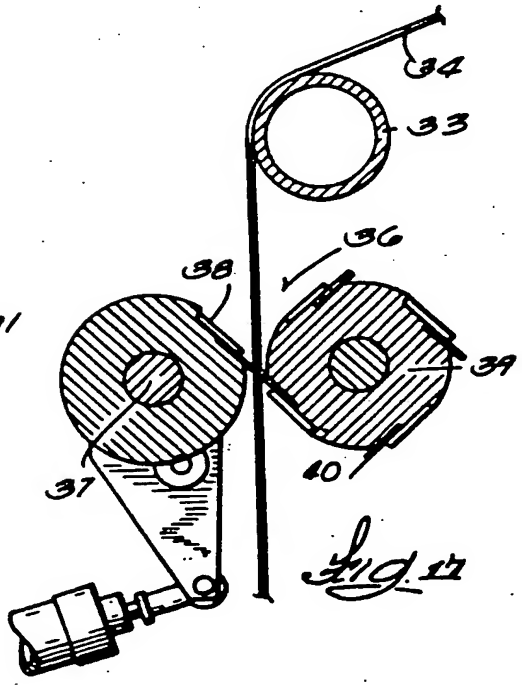


Fig. 17

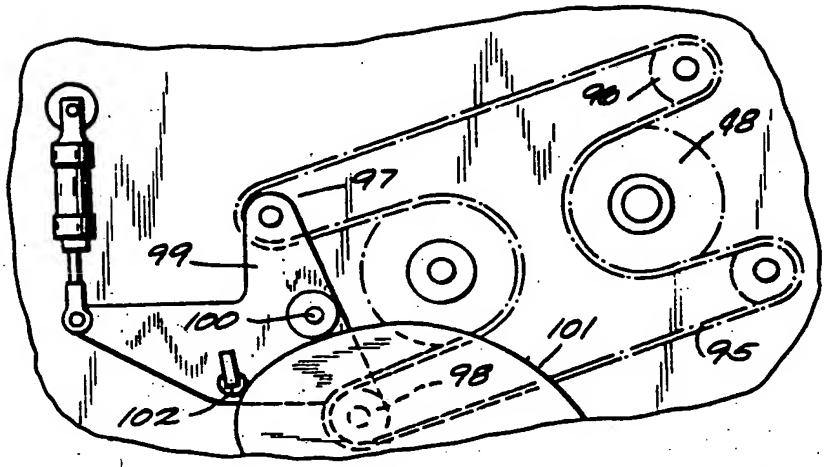


Fig. 16

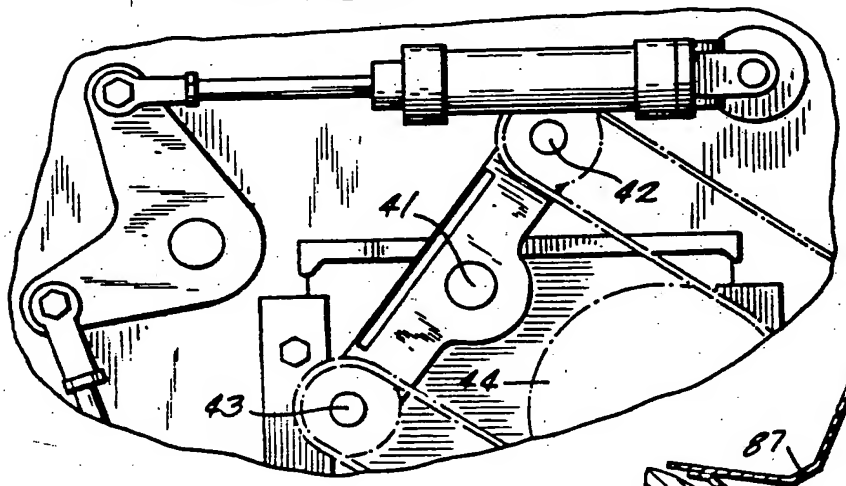


Fig. 18

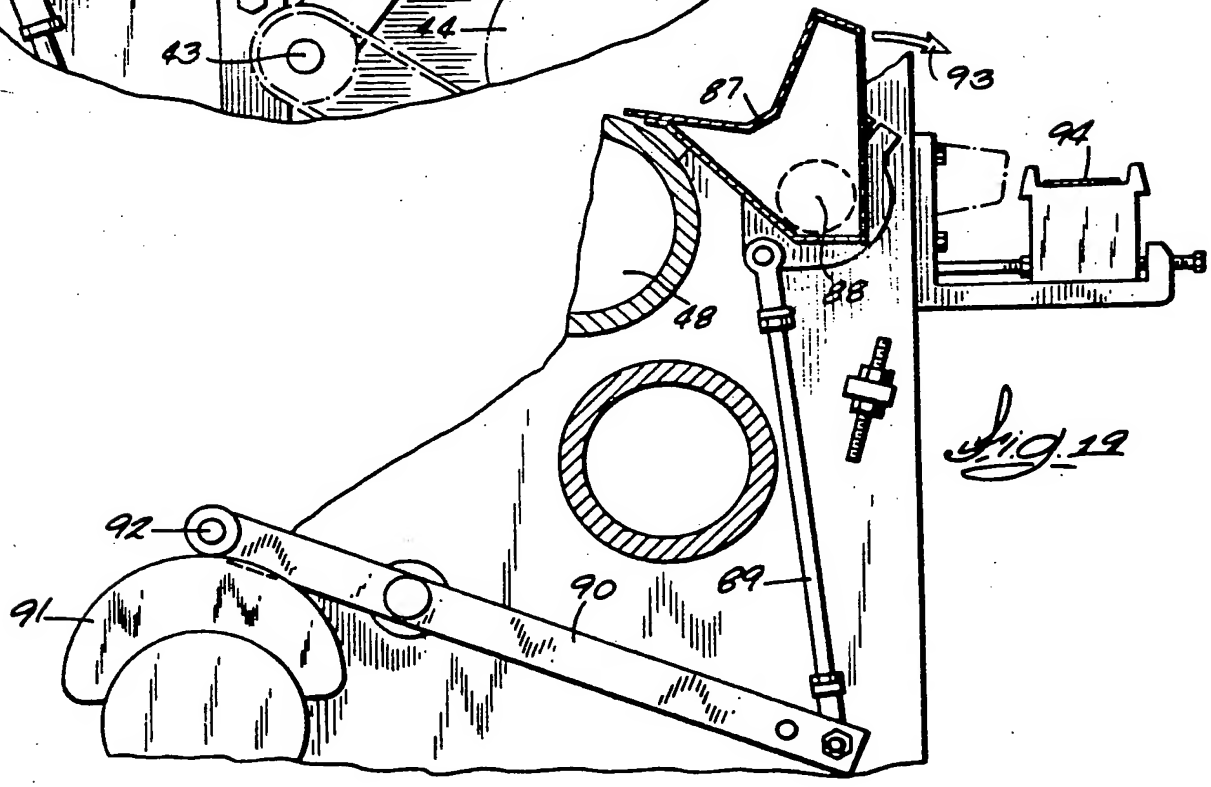


Fig. 19

SPECIFICATION

Apparatus for snap-separation of web material

The present invention relates to equipment for winding webs of sheet material such as paper, plastic, metal foil, etc., as well as to the method for winding such webs, and relates more particularly to equipment which rewinds larger rolls of paper into smaller rolls, which equipment is known in the paper industry as a high speed automatic re-winder.

This application is related to co-pending application No. 8211087 (Serial No. 2105688) which describes web perforation and other forms of web separation devices, but is directed specifically to a novel method of separating a web without cutting. It describes apparatus for snap-separating the web at a precise location to provide exact sheet-count and web-length as the web is stretched between a completed roll or log of paper and a core which is brought into contact with said web closely adjacent said completed roll.

It will be seen from the following description that the web is "snapped" between accelerating rolls and decelerating rolls and in this respect the device of the present invention differs from previous rewinders which used knives, vacuum boxes, air pressure and the like to effect the web separation.

In the apparatus and process for re-winding large parent rolls of paper onto cores for smaller consumer size rolls, one of the critical aspects of the process and apparatus is the accurate severence of the web at a predetermined sheet-count or sheet length, and the instantaneous transfer of the newly formed leading edge of the web onto a new core so that the subsequent winding of the next roll may take place. At this same instant the just-completed roll of paper must be discharged from the winding area.

The separation of the web, securing of the "tail" of the web to the completed roll, the securing of the new leading edge of the web to a new core and the removal of the finished roll from the apparatus must take place without slowing down the machine which is running at very high speed.

To accomplish this web separation and changeover there have been many previous devices proposed, not the least important of which is the Perini system illustrated in the series 800 Perini Machine, as described in Patents issued to Perini in Italy (No. 963047) and Great Britain (No. 1435525) as well as in the aforementioned co-pending British Patent application.

According to the invention there is provided apparatus for snap-separating a continuous moving web as set out in claim 1 of the claims of this specification.

An example of the present invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a vertical cross-sectional view of the wind-up portion of an automatic re-winder.

Figure 2 is an enlarged drawing of the basic winder rolls and diameter control roll illustrating the disposition of a core as well as a completed small diameter log and a completed large diameter log.

Figures 3, 4, 5, 6 and *7* are views similar to Figure 2, illustrating the operation of the re-winder when a glue-carrying core is involved in the transfer and web separation,

Figures 8 - 12 inclusive are similar to Figure 2 and illustrate the optional form of operation of the web separation and transfer mechanism of the present invention when no adhesive is utilized.

Figure 13 illustrates a core-advancing mechanism for inserting a core into the throat between the first and second winding rolls.

Figure 14 is a schematic sectional view of the mechanism for controlling the elevtion of the diameter control roll.

Figure 15 is a fragmentary sectional view of the belt and linkage mechanism for accelerating and decelerating the diameter control roll.

Figure 16 is a schematic diagram of the belt and linkage mechanism for controlling the acceleration and deceleration of the second winding roll.

Figure 17 is a vertical cross-sectional view of the web-perforating means.

Figure 18 is a schematic diagram of the drive control mechanism for the control of the position of the web-perforating roll.

Figure 19 is a partial sectional view of the cam and link mechanism for controlling the log-discharge carrier.

Referring now to Figure 1 there is illustrated a back-stand or frame 31 which supports the rewinding equipment of the present invention.

A guide roll 32 and a turning roll 33 are supported at the upper end of the frame so as to receive a web of paper 34 travelling in the direction of the arrow 35 and to guide the web downwardly into the rewinder mechanism.

The web 34 is brought to the roll 32 from a back-stand or support which holds a large parent roll of paper and is constructed and arranged so that the parent roll may be rotated and the web 34 may unwind therefrom at the appropriate tension and speed desired.

As the web descends from the turning roll 33 it passes a perforating station 36 which is designed to apply a series of lines of perforations across the web as the web passes between a non-rotating member 37 which carries a cutter knife or blade 38, and a rotating knife-roll 39 which has a plurality of cutter knives 40 mounted thereon.

Rotation of the cutter roll 39 which brings the blades 40 into contact with the stationary perforating blade 38 is appropriately timed in relation to the linear speed of the web 34 as it descends through the perforating station so as to put an appropriate line of perforations every several inches across the web 34.

The perforation station is shown more clearly in Figure 17 and the mechanism for rotating the position of the rotatable roll 39 is shown more clearly in Figure 18.

Thus if it is desired to modify the location of a line of perforations at the throat 47, suitable drive mechanism operated by cams or otherwise may adjust the position of the shaft 41 shown in Figure 18. This causes the turning rolls 42 and 43 to pivot about the axis of the roll 41. This will turn the drive

mechanism 44, which is indirectly connected to the rotary blade holder 39.

This adjustment permits the blades 40 to be moved forward or backward; thus to change the location of the line of perforations in the throat 47 and thereby accurately to locate a line of perforations at the position where the snapping of the web will take place.

After the web 34 has been provided with sequential rows of perforations, the web descends from the perforating station 36 where it is brought into contact with the surface of a first winding roll 46. As is shown in Figure 1, the web 34 is carried by the surface of the roll 46 therebeneath and into the throat 47 created by surfaces of the spaced first winder roll 46 and its juxtaposed second winder roll 48. This relationship of the rolls 46 and 48 is more clearly shown in Figure 2.

The width of the throat 47 between the rolls 46 and 48 is slightly less than the outer diameter of a core 49 which is brought into the throat 47 and upon which the web 34 will be wound after the web passes beneath the roll 46.

Referring once again to Figure 1, there is shown above the frame 31 a hopper or trough 50 which is constructed and arranged to hold a pluarlity of cores or tubes 51. This storage reservoir or hopper 50 has a vertical guide slot or trough 52 radially disposed therebeneath so that a stack of cores 51 may descend therein from the hopper 50 to a glue applicator station 53.

The glue applicator station 53 may consist of a rotating member 54 which has a plurality of slots 55 (three of such slots are shown in Figure 1, disposed at 120 degrees from each other).

The slots are surrounded by a plurality of rider rolls 56 onto which the cores 51 drop when the slot is in the uppermost position, as shown in Figure 1.

When the rotary member 54 rotates in the direction of the arrow 57, a core which had been placed in the uppermost slot 55 is carried past the glue-applicator station 58 which includes a rotating glue-applicator wheel 59. As the core passes the wheel 59, the wheel 59, which is rotating in a bath of adhesive 60, carries the adhesive from the bath against the surface of the core 51, in selected positions determined by raised portions on the wheel 59, thus rotating the core against the guide members 56 and applying circular strips of glue in a plurality of locations along the length of the core 51.

Thereafter the continued rotation of the member 53 in the direction of the arrow 57 brings the core 51 to the position 61 from whence it is discharged by gravity along the chute 62 to rest at the position 63 shown in dotted lines at the lowermost portion of the chute 62.

At an appropriate moment, the core lifter mechanism (shown more specifically in Figure 13) lifts the core 51 from the position 63 and brings it into the throat 47 where, because it is slightly larger in diameter than the width of the throat, the core is pinched between the rotating first winder roll 46 and the second winder roll 48.

As will be described more fully hereinafter, at the moment the core 51 is pushed into the throat 47 by the pusher wheel 64 on the arm 65, the peripheral speed of the roll 48 has been decreased with respect to the peripheral speed of the roll 46 so that the core 51 is caused to rotate between the two rolls in the direction indicated by the arrow 66.

During this rotary action, the web 34 is pinched between the core and the first winder roll 46, adhesive is transferred from the core to the web and the web is tightly constrained between core and roll 46.

The timing of the lifter arm 65 to bring the core into the throat 47 is carefully controlled by the cam 67 and cam follower 68, and this timing is precisely maintained with respect to the speed of rotation of the other rolls in the machine and to the linear speed of the web 34.

As soon as the web 34 is wrapped around the core, the continued rotation of rolls 48 and 46 (being differentially driven so that the faster speed of the roll 46 bears against the web and core), the core is rotated out of the throat 47 into the position above the roll 48 where it continues in contact with the roll 48 and the roll 46, getting increasingly larger in diameter as shown by the dotted lines in Figure 2.

Immediately after the core passes out of the throat 47 on top of the roll 48, the rotational speed of the roll 48 is increased until its peripheral speed is the same as the roll 46 and the linear speed of the web 34 and thus the winding continues upon the core with the roll or log of paper (which is being formed on the core) maintaining contact with the surfaces of the rolls 46 and 48.

As will be seen in both Figures 1 and 2, a diameter control roll 69 is disposed above the second winder roll 48 and carried by an arm 70 which rotates about the axis 71.

This diameter control roll is arranged so as to be firmly in contact with the upper surface of the log of web material as it is wound between the rolls 46 and 48 and thus the surface speed of the diameter control roll 69 is the same as the surface speed of the rolls 46 and 48 during the winding operation. Additionally, the mechanism for controlling the elevation of the diameter control roll 69 is shown in Figure 14. In this Figure, the cam 72 bears against a cam follower 73 on an arm 74 which lifts a connecting rod 75. The upper end 76 of the shaft 75 is appropriately connected through linkages so as to rotate the arm 70 about the axis 71 under controlled restraint, and thus accurately to define and control the diameter of the log being wound on the core.

The connecting rod 75 is connected to the arm 74 by the sliding bracket 202. A pivot 204 connects the bracket 202 to the rod 75. The bracket 202 can be moved along the arm 74 by turning the handle 200 and the screw 201 and thus change the dimensions of the distances between the follower 73 and pivot 204 and between the pivot 204 and the pivot 203. This arrangement permits the adjustment of the log diameter while the machine is running and thus to change the log diameter without having to stop the machine.

Additionally, the position of the diameter control roll 69 is carefully controlled, both for acceleration and deceleration, and the mechanism for providing

for this deceleration and acceleration is shown in Figure 15. The axis 71 rotates under the control of a pulley 77, shown particularly in Figure 15. This pulley 77 is wrapped by a drive-belt 78 which passes around a plurality of guide pulleys, two of which (No. 79 and No. 80) are mounted on an arm 81 which pivots about an axis 82 mounted in bracket 83, which bracket itself is pivoted about the axis 84.

A cam 85 bears against a cam follower 86 mounted on the arm 81, causing the arm 81 to pivot about the axis 82, thus moving the belt 78 with respect to the axis of the roll 77.

During most of the operation of the equipment, the surface speed of the rolls 46, 48 and 69 is the same (i.e. the linear speed is the same) so as to cause the web 34 to wind up on the core to a pre-chosen position as shown in Figure 2.

When it is desired to discharge the fully wound log from the position shown in Figure 2, the surface speed of the diameter control roll 69 and the second winding roll 48 may be modified so that the peripheral speed of the roll 69 is greater than that of the roll 48 whereupon the log is ejected from the position shown in Figure 2 to pass into a log receiving hopper 87 shown in Figure 19.

When the log of wound paper is discharged into the hopper 87, the hopper is subsequently rotated about the axis 88 by the arm 89 which is moved under the influence of the lever 90 pushed by the cam 91 against the cam follower 92. This rotates the hopper 87 in the direction of the arrow 93 depositing the log upon the log-carrying conveyor 94. After that the hopper returns to the position shown in Figure 19 ready to receive the next log of web material.

The mechanism for accelerating and decelerating the second winder roll 48 is shown in Figure 16 wherein a belt 95 wraps around a portion of the roll 48 and a plurality of guide rolls 96, two of which 97 and 98 are carried by the arm 99 which pivots about the axis 100 under the influence of the cam 101 bearing it against a cam follower 102 secured to the arm 99.

When desired, the cam 101 is rotated, causing the arm 99 to pivot about the axis 100 thus changing the position of the rollers 97 and 98 and causing relative movement in the roll 48 so as to either increase or decrease the speed of rotation of the roll 48 as is desired.

From the foregoing it can be seen that the relative speeds of rolls 46, 48 and 69 can be nicely and carefully controlled with respect to the linear speed of the web 34 as it passes through the rewinding mechanism. As it has been stated earlier, under most circumstances, the linear web speed and the peripheral speed of the rolls 46, 48 and 69 is the same. However, when it is desired to introduce a core into the throat 47, the roll 48 may be decelerated with respect to the roll 46.

At the same time the deceleration of roll 48 with respect to the rotary speed of the roll 69 causes the log to move out of the finished position as shown in Figure 2 in a manner to create a strip or length 104 of the web material 34 between the position where the core and roll 46 pinch the web between each other and the upper surface of the finished roll. This tensioning and web creating situation is shown more clearly in Figures 3 - 7 inclusive and Figures 8 - 12 inclusive which will now be described.

In Figure 3 the glue-carrying core 49 is brought into position a small distance in advance of the throat 47 while the rolls 46, 48 and 69 are operating at the same peripheral speed.

The log 103 is just finishing its winding operation under the influence of the three rolls. As the core-pusher 65 moves the core 49 further into the throat 47, the web 34 is pinched between the core and the roll 46 and at the same moment the roll 48 is decelerated causing the core to roll forwardly into the throat along with the web 34.

At this moment the log 103 also begins to move out of the winding position because of the deceleration of the roll 48 to a position shown in Figure 5. At this position a length 104 of the web 34 is created between the log 103 and the core 49.

At the same instant, the roll 69 is decelerated to bring it into the same peripheral speed as the roll 48 so that the log 103 remains in position between the rolls 48 and 69.

Referring now to Figure 6, the rotary speed of the roll 69 is increased with respect to the roll 48 causing the log 103 to move still farther away from the throat and thus, as is shown in Figure 7, snapping or tearing the web 34 along the length 104.

As the core 49 was introduced into the throat 47, the peripheral strips of adhesive on the core were transferred to the web 34 along a portion of the web which creates the web portion 104. After the web is separated along the portion 104, some of the adhesive is retained on the "tail" 105 and some is retained on the leading edge 106 of the web, thus the adhesive can be utilized to "tie" the tail 105 to the log and also to adhere the leading edge 106 to the core 49.

Continued rotation of the roll 69 at a speed faster than the roll 48 ejects the log into the log-receiving hopper 87 while at the same time the slower rotary speed of the roll 48 with respect to roll 46 moves the core and web out of the throat into the winding position with the web securely held to the core by the adhesive material.

Whereupon the cycle is repeated until the new log is wound to the appropriate diameter and web length whereupon the separation and transfer cycle is repeated.

It must be stated at this point that the transfer procedure and mechanism shown in Figures 3 - 7 inclusive may be used with or without adhesive and the choice of using or not using the adhesive may be dependent upon several factors, including the type of web material and the speed of operation.

Referring now to Figures 8 - 12 inclusive, there is shown a procedure similar to that shown in Figures 3 - 7 inclusive.

In Figure 8 the rolls 48, 46 and 69 are rotating at the same peripheral speed until the log 103 is wound to the proper diameter and the core 49 is introduced to the entrance to the throat 47.

In Figure 9, the roll 48 is decelerated, causing the core 49 to enter the throat and come into contact with the web 34.

The deceleration of the rolls 48 and 69 also cause the log 103 to move away from the throat to the position shown in Figure 9, creating the length 104 of the web 34 between the core 49 and the top of the log 103.

Thereupon the roll 69 may be decelerated, with respect to the rotary speed of the roll 48, causing the log 103 to move back towards the throat creating a loop or slack 105 in the web portion 104.

At this time the web is also beginning to wrap the core 49 and, as is shown in Figure 11, a portion of the leading edge of the web is caught between the core and the roll 48, at the position 106, creating the tension in the sheet between the nip between the core and the roll 48 and the web which is on top of the log 103.

Referring now to Figure 12, the roll 69 is once again accelerated, snapping the paper or tearing or rupturing it in the taut or tightened loop 105, separating the web which continues to wind on the new core at the throat position and causing the completed log to move away from the throat under the continued differential speed between rolls 48 and 69, with 69 moving faster than 48.

From the foregoing description, it can be seen that the differential speed control mechanism described previously provides means for selectively controlling the peripheral speed of the rolls 46, 48 and 69 as well as the linear speed of the web 34 so precisely that the log 103 may be held in a "dancing" position between the rolls 48 and 69, moving the log 103 toward the throat or away from the throat, as desired, to create the slack or loop 105 sufficiently to enable the leading edge to be pinched between the core and the roll 48 while the web is still wound on the log 103 and then subsequently accelerating the roll 69 in such a manner as to cause the web to snap along the length 105 and permit ejection of the log into the hopper 87 and thereafter the winding cycle may be repeated.

Although there have been illustrated selective means for adjusting the acceleration and deceleration of the various rolls and for controlling the position of the diameter control roll, it is to be understood that different drive mechanisms such as cone drive pulleys, P.I.V. drive and the like may be substituted, all within the scope of the invention.

In Figure 12, there are shown in dotted lines, optional auxiliary guide belts for rolls 48 and 69. These belts effectively extend the surfaceS of the respective rolls and provide surfaces on which the log 103 may be guided as it "dances" between rolls 48 and 69, thus more assuredly controlling the rotation and movement of the log as it is shifted back and forth to create the loop 105 and the snapping of the web-length 104.

This application is divided from co-pending application No. 8216620 (Serial No. 2105688) which describes and claims a method for snap-separation of web material and contains much common subject matter.

CLAIMS

1. Apparatus for winding web material on to a core to form a log of web material, comprising means for advancing a web, a first winder roll, a second winder roll, a throat formed between the spaced surfaces of the first and second winder roll, means for advancing a core to the throat, the width of said throat being less than the outer diameter of the core, a diameter control roll, means for rotating each of the first winder roll, the second winder roll, and the diameter control roll, differential speed control means for said second winder roll, which causes the second winder roll to have a peripheral speed slower than the peripheral speed of the first winder roll, causing said core to rotate and advance through said throat, differential speed control means for said diameter control roll whereby to change the peripheral speed of said diameter control roll with respect to the peripheral speed of the first winder roll, and also with respect to the peripheral speed of the second winder roll, means for guiding said web material around said first winder roll and into said throat, between said core and said first winder roll, and causing said web to wind around said core as said core rotates through said throat, a web-separation device which utilizes a temporary differential rotary speed of the driving roll mechanism, and means to modify the location of a line of perforations for the web separations.

2. Apparatus as claimed in claim 1, including means for holding said diameter control roll against the top of the web which is wound upon said core, whereby to limit and control the outer diameter of the log of web material wound upon said core.

3. Apparatus as claimed in claim 1 or claim 2, wherein the differential speed control means causes said second winder roll to have a peripheral speed slower than the peripheral speed of the diameter control roll, whereby to cause the log to move away from said throat, creating a length of web material between the throat and the log.

4. Apparatus as claimed in claim 3, including means to change the peripheral speed of the diameter control roll and the peripheral speed of the second winder roll, whereby to cause said log to return towards said throat, creating in said throat a loop of web material which is pinched between the second winder roll and a second core which has been advanced into said throat.

5. Apparatus as claimed in claim 4, wherein the differential control means for the second winder roll and the diameter control roll cause said log to move away from said throat faster than said first winder roll advances the web into the throat whereby to cause the web to separate in the area between the throat and the log of web material.

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